SOLIDAGO (ASTERACEAE) IN OKLAHOMA AND TEXAS

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ABSTRACT

There are 25 species of *Solidago* (Goldenrod) in Oklahoma and Texas, with 10 species having two varieties each and one species having four varieties for a total of 38 taxa in this treatment. Information includes keys, data on type specimens, distribution maps, drawings of typical leaves, synonymy, discussion of differentiating characteristics, habitat, and one new combination: *Solidago velutina* var. *nevadensis* (Gray) C. & J. Taylor.

INTRODUCTION

Solidago is a North American genus (one Eurasian and two South American species) containing about 75-85 species (Kartesz and Kartesz, 1980; Soil Conservation Service, 1981). Its morphological variation has contributed to a proliferation of names that is matched by only a few other genera. Index Kewensis (1895) lists 361 species of *Solidago* up to 1885. Some of these taxa have since been transferred to other genera, but most lie within the current concept of the genus.

This treatment of *Solidago* excludes *Euthamia* which most taxonomists now consider to be a separate genus (Anderson & Creech, 1975; Sieren, 1970; Taylor & Taylor, 1983). It includes the section *Oligoneuron* and *S. ptarmicoides* (Anderson & Creech, 1975, Brouillit & Semple, 1981; Kapoor & Beaudry, 1966). While *S. ptarmicoides* fits better in *Aster*, it has been reported to form hybrids with *Solidago* taxa.

DISCUSSION

Oklahoma and Texas lie at the southern end of the Great Plains and have great plant diversity. The vegetation includes the swamps and wetlands interspersed within the eastern deciduous forest of the Gulf Coastal Plain. The Ouachita Mountains of Oklahoma are allied to the plateaus of Kentucky and Tennessee, and provide outposts for many species at their southwestern limits of range. The grasslands are varied; Oklahoma's are mostly allied with the grasslands of the northern Great Plains; and Texas has its blacklands, coastal prairies and various semiarid grasslands. Farther west, both Oklahoma and more substantially Texas have elevations sufficient to maintain some elements of the Rocky Mountain biota. Most *Solidago* species are therefore limited in range within the states. If a species is found

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throughout the area, it is represented by several varieties. The two most commonly collected species, based on specimens in herbaria, are *Solidago canadensis* (including *S. altissima*) and *S. gigantea. Solidago auriculata, S. sempervirens, S. stricta, S. tortifolia,* and *S. wrightii* are found only in Texas, while *S. hispida* and *S. ptarmicoides* occur only in Oklahoma.

The extreme variation in climate produces morphological variation in response to extremes of rainfall, temperature, and other stress limits for survival. This phenotypic plasticity of perennial plants often results in a species being named several times. As Oklahoma is between the southern coastal and central Missouri and Kansas centers of botanical activity, many species are passing under different names in adjacent state floras or atlases.

Other environmental factors affect appearance as 1) leaf drop during a dry season, 2) insect eggs laid in the apical meristem causing atypical lateral branching that produces unusual inflorescence shapes and smaller leaves, 3) mowing of roadsides and cattle grazing produce the same results, 4) there are also indications that interaction of photoperiod, time of flower initiation, and inflorescence branching often causes the southern varieties to have a larger more diverse inflorescence. The lower branches are much longer, and the heads usually occur only toward the tip with the lower branch being leafy.

Species with long rhizomes can grow into large clones covering an acre or more; occasionally such clones form a small clump if unfavorable growing conditions exist. A large population presents a uniformity in one field which contrasts with the next clone in an adjacent field and thus, appears very different. Many of these populations have been named as distinct entities (*S. canadensis* for example). Those taxa with a bunch or cluster of stems in which large populations are composed of numerous genetically different individuals have a baseline of greater morphological variation resulting in a broader species concept which generally limits the number of times the taxon has been named (*S. nemoralis* for example).

Many nomenclatural problems have resulted from the phenotypic plasticity of glodenrods, but environment and proliferation of names do not totally account for the complexity of the genus. The base chromosome number of *Solidago* is n = 9, but some species have counts of n = 18 and n = 27. In some instances, chromosome levels can be correlated with distinct morphological features, but in others, diploid and tetraploid individuals can not be distinguished (Beaudry, 1960, 1963, 1968, 1969; Beaudry et al., 1958, 1959; Kapoor & Beaudry, 1966). Chromosome counts are given for species and when a count is from a plant growing in the study area, the location is given. It should be noted that a number of chromosome reports have been based on misidentified plants.

ARRANGEMENT

There are 25 species of *Solidago* in Oklahoma and Texas with 10 having two varieties each and one having four varieties for a total 38 taxa. Species are numbered and arranged in alphabetical order after the key. Types are noted or designated where feasible. County dot maps are alphabetical except for *S. mollis*, which precedes *S. missouriensis* for clarity of presentation (Figs. 1, 2, 3). For identification and comparison, typical leaves are presented with similar species being placed together (Fig. 4, 5, 6, & 7). Since Correll & Johnston (1970) and other authors have extensive species descriptions, the discussion following each species is designed to emphasize those characteristics most helpful in identification.

KEY TO SOLIDAGO IN OKLAHOMA AND TEXAS

1. Inflorescence corymbose, flat-topped or nearly so.
   2. Involucral bract with several nerves.
      3. Leaves ovate, usually densely pubescent ..... *S. rigida*
      3. Leaves linear to linear-lanceolate, glabrous ..... *S. nitida*
   2. Involucral bract with midnerve only.
      4. Ray flowers white; in south central Oklahoma ..... *S. ptarmicoides*
      4. Ray flowers yellow; in southwestern Texas ..... *S. wrightii*
1. Inflorescence racemose to paniculate, cylindric or widely pyramidal.
   5. Inflorescence racemose, less than 3 cm wide.
      6. Heads axillary, or leafy braceted in lower portion with lanceolate leaves much longer than any axillary racemes ..... *S. caesia*
      6. Heads racemose to narrowly paniculate, leaves in inflorescence small, reduced.
         7. Primary stems glabrous, leaves usually glabrous, the upper appressed, basal leaves 10–30 cm long.
            8. Basal leaves ovate to broadly lanceolate, stem leaves ovate, toothed, the upper leaves small, appressed ..... atypical forms of *S. salicina*
            8. Basal leaves linear, stem leaves linear to narrowly lanceolate, entire.
               9. Leaves just below inflorescence about 2 mm wide, appressed ..... *S. stricta*
               9. Leaves just below inflorescence wider than 2 mm, not appressed ..... *S. sempervirens*
         7. Primary stems pubescent, leaves usually pubescent, basal leaves absent or less than 12 cm long.
            10. Plants densely pubescent with long spreading hairs; stems usually 1 or 2 ..... *S. hispida*
            10. Plants with short appressed hairs; stem several per clump.
                11. Leaves linear ..... depauperate forms of *S. altiplanities*
                11. Leaves ovate to broadly lanceolate.
                    12. Basal leaves spathulate to ovate or elliptic, blunt with 1–5 shallow teeth; stem leaves rapidly reduced up stem; heads less than 6 mm tall. ..... *S. velutina*
                    12. Basal leaves absent; stem leaves uniform, acute; heads 6 mm or longer.
                        13. Plants of Trans-Pecos ..... *S. wrightii*
                        13. Plants of central and eastern area ..... *S. petiolaris*

5. Inflorescence paniculate, broadest at base, much wider than 4 cm.

14. Primary stem glabrous, rarely with sparse hairs; leaves usually glabrous.

15. Inflorescence essentially glabrous.

16. Leaves broadly ovate, toothed; plants of wooded habitats.

17. Basal rosette of long petiolate ovate leaves, reduced up stems to ovate sessile leaves; heads 6 mm long, pedicellate; achenes striate, pubescent .... *S. arguta*

17. Basal leaves absent, lower stem leaves deciduous at anthesis; heads 5 mm or less, achenes not striate .... *S. ulmifolia*

16. Leaves oblanceolate, toothed toward tip, frequently with fastigiate leaves; plants of grasslands .... *S. missouriensis*

15. Inflorescence densely pubescent.

18. Inflorescence racemose to narrowly paniculate, ends of branches erect; heads not secund.

19. Plants eglandular-pubescent; grasslands east of Trans-Pecos .... *S. speciosa*

19. Plants frequently glandular pubescent; Trans-Pecos .... *S. wrightii*

18. Inflorescence broadly paniculate, triangular in outline, ends of branches recurved; heads secund.

20. Basal rosette absent; lower leaves absent at anthesis; stem leaves uniform in size.

21. Leaves lanceolate .... *S. gigantea*

21. Leaves ovate .... *S. ulmifolia*

20. Basal rosette present; lower leaves 10–30 cm long; leaves reduced upward.

22. Basal leaves linear-lanceolate; pedicels over 10 mm long .... *S. sempervirens*

22. Basal leaves ovate, toothed; pedicels less than 5 mm long .... *S. salicina*

14. Primary stem pubescent; leaves usually pubescent.

23. Leaves linear.

24. Inflorescence conical, branches erect; leaves up to 9 cm long .... *S. altiplanities*

24. Inflorescence pyramidal, branches recurved apically; leaves 5 cm or less long.

25. Stem with narrow lines of pubescence to pubescent except for band below leaf node; leaves glandular-dotted .... *S. odora*

25. Stem densely pubescent; glandular dots obscure or absent .... *S. tortifolia*

23. Leaves lanceolate, ovate, or elliptic.

26. Stem leaves auriculate, clasping stem .... *S. auriculata*

26. Stem leaves sessile or petiolate, not auriculate.

27. Inflorescence branches erect, not recurved apically; panicle narrow.

28. Leaves ovate to elliptic, densely pubescent; stems 1 or 2 per plant; eastern woods .... *S. hispida*

28. Leaves lanceolate to broadly lanceolate, glabrate; stems more than 2 per plant; prairies .... *S. speciosa*

- 27. Inflorescence branches recurved, heads secund; panicle triangular in outline.
  - 29. Leaves serrate.
    - 30. Leaves ovate; leaf venation prominently reticulate beneath with long hairs .... *S. rugosa*
    - 30. Leaves lanceolate; reticulation inconspicuous beneath, with three nerves .... *S. canadensis*
  - 29. Leaves mostly entire or occasionally with apical teeth on larger leaves.
    - 31. Leaves lanceolate or linear to spathulate, usually more than 5 times longer than broad.
      - 32. Leaves 1-nerved, spathulate.
        - 33. Leaves rather uniform up stem, inflorescence pyramidal, endemic to north central Texas and south central Oklahoma .... *S. mollis*
        - 33. Leaves reduced up stem, inflorescence mostly longer than broad, widespread .... *S. nemoralis*
      - 32. Leaves 3-nerved, lanceolate.
        - 34. Inflorescence pyramidal; stem leaves uniform; heads 5 mm tall, or less .... *S. canadensis*
        - 34. Inflorescence longer than broad; stem leaves reduce upward; heads 6 mm tall .... *S. velutina*
    - 31. Leaves broadly lanceolate to elliptic, 2–4 times longer than broad.
      - 35. Plants of Rocky Mountain foothills; heads 6 mm tall; inflorescence branches usually recurved and secund .... *S. velutina*
      - 35. Plants of plains, escarpments, or rocky hills; eastern and central.
        - 36. Inflorescence always compact and dense; leaves broadly ovate, rarely toothed, usually less than 3 cm long .... *S. mollis*
        - 36. Inflorescence dense to open; longer lower branches with leaves ovate, less than 1 cm long .... *S. radula*

1. SOLIDAGO ALTIPLANITIES C. & J. Taylor. Sida 10:178. 1983. *High Plains Goldenrod.* Figs. 1, 4.

TYPE: OKLAHOMA. Jefferson Co.: 5.6 mi SW of Waurika, 9 Oct 1981, *J. & C. Taylor 31007* (HOLOTYPE: DUR; ISOTYPES: GH, MO, NLU, NY, OCLA, SMU, US, WTS).

Plants clumped to spreading in small clones, uniformly covered with short curved hairs; leaves linear and sometimes twisted. It could be confused with *S. canadensis* because of its pubescence, but it does not grow in the same habitat. This taxon is mostly confined to canyons, escarpments and gypsum outcrops of the Red River valley in the high plains area of Oklahoma and Texas.

2. SOLIDAGO ARGUTA Ait. var. BOOTTII (Hook.) Palmer & Steyerm. Ann.

Missouri Bot. Gard. 22: 659. 1935. *Boott's Cutleaf Goldenrod.* Figs. 1, 5.

S. boottii Hook. Companion Bot. Mag. 1:97. 1835. TYPE: LOUISIANA. [New Orleans, Lake Pontchartraine?], [Summer 1832], *Drummond* 465 (Hooker's assigned number; K?).

This species is usually confused with *S. ulmifolia* because of the similarity of the upper primary stem leaves (both ovate and toothed). *Solidago arguta,* however, has basal rosettes, frequently separated by rhizomes from the base of the flowering stalk, and the lower stem leaves are long-petiolate and usually persistent at flowering. *Solidago ulmifolia,* on the other hand, never has a basal rosette, and the lower stem leaves are early deciduous. It also has smaller flower heads which are more crowded. Both species have forms with the lower inflorescence branches up to 30 cm or longer with flowers only toward the ends. This species is rare or rarely collected in east Texas, but it is common in the Ozark and Ouachita Mountain areas of Oklahoma where it grows in shaded areas in the oak-hickory forest. Taylor & Taylor (1978) has further discussion and history of Oklahoma occurrence.

3. SOLIDAGO AURICULATA Shuttlew. ex S. F. Blake. J. Wash. Acad. Sci. 21:326. 1931. *Clasping Leaf Goldenrod.* Figs 1, 7.

TYPE: LOUISIANA, *Leavenworth* (LECTOTYPE: NY; *microfiche* DUR!); Florida, *Chapman*; Missouri, *Duerinck.*

S. amplexicaulis Martens, Bull. Acad. Brux. 8:67. 1841. = *S. riddellii.*
S. amplexicaulis Gray, Syn. Fl. N. Amer. 1(2):153. 1884.

According to Gray (1884), Shuttleworth distributed collections of Leavenworth, Chapman, and Rugel (from Louisiana to Florida) as *S. auriculata.* Gray also notes that *S. amplexicaulis* Martens is a synonym of *S. riddellii* Frank.

The auriculate, clasping leaves are very distinctive, and this species can be readily separated. It is an infrequent plant of the eastern United States, just barely reaching extreme eastern Texas.

4. SOLIDAGO CAESIA L.

KEY TO VARIETIES

1. Stems round; leaves not decurrent .... var. *caesia*
1. Stems striated; leaves decurrent .... var. *curtisii*

4a. S. CAESIA L. var. CAESIA. Sp. Pl. 2:879. 1753. *Blue-stem Goldenrod.* Figs. 1, 7.

TYPE: "Habitat in America septentrionali, based on Dill. Hort. Eltham. 414 t. 307, f. 395;" sheet 14 labeled *S. flexicaulis* (LINN; microfiche US!).

The axillary clusters of flowers in the leaf axils are distinctive with the leaves narrowly lanceolate to broadly ovate. Despite the common name, our plants have stems either magenta or green. This is the most common variety in moist oak-hickory forests of Oklahoma and Texas. 2n=18 (Beaudry, 1963; Solbrig et al., 1964).

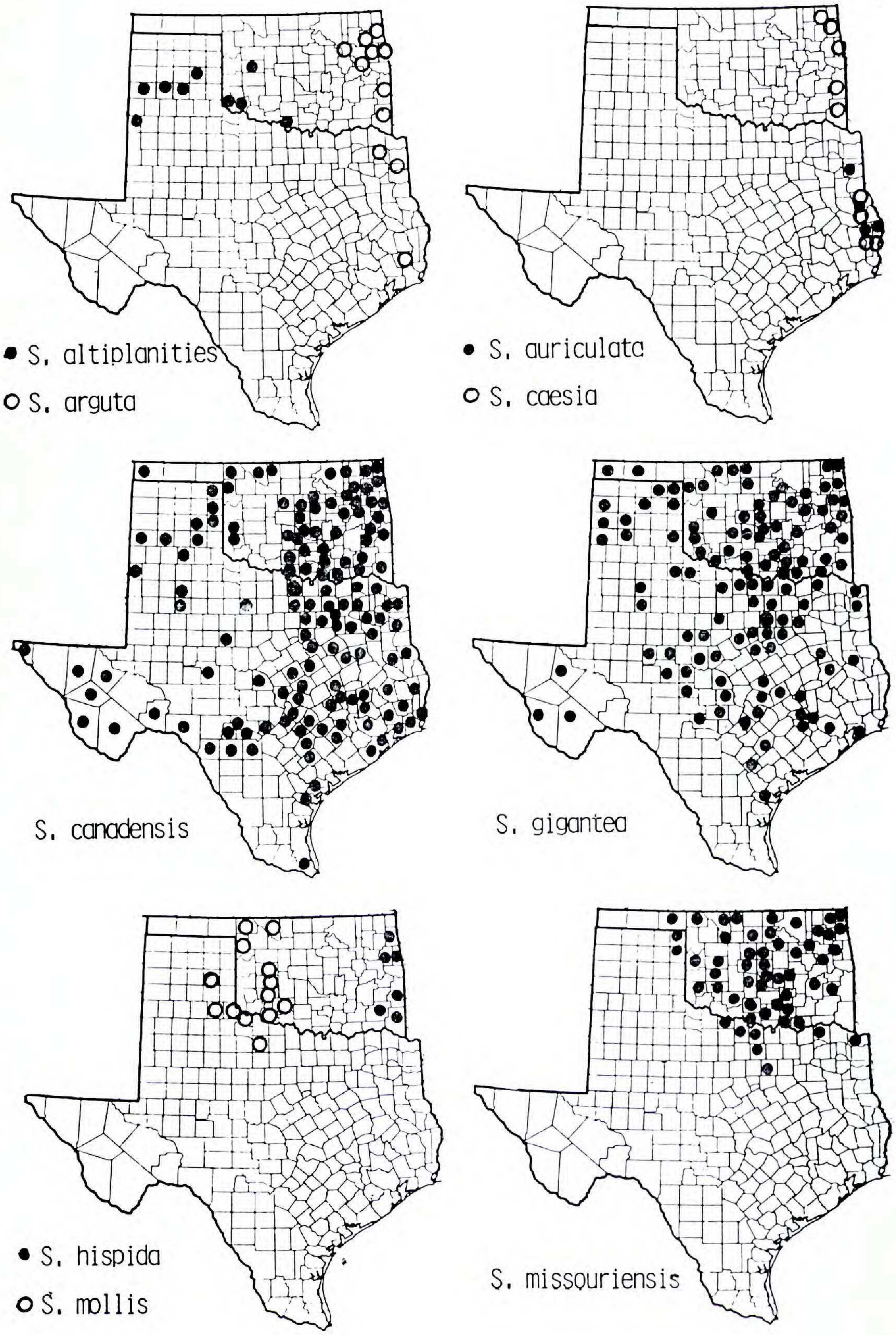
● S. altiplanities
○ S. arguta
● S. auriculata
○ S. caesia
S. canadensis
S. gigantea
● S. hispida
○ S. mollis
S. missouriensis

Figure 1.

4b. var. CURTISII (T. & G.) Wood, Classbook. 432. 1861.

S. curtisii T. & G. Fl. N. Amer. 2:200. 1842. TYPE: NORTH CAROLINA. Black Mountains, alt. 4500 ft, Sep, *M. A. Curtis 1310* (PH!, UARK!).
S. caesia var. *curtisii* (T. & G.) C. & J. Taylor. Sida 10:181. 1983. Superfluous name.

The decurrent leaves and striated stems are the distinctive characters. This variety is occasional in eastern Texas and is more common farther east. Taylor & Taylor (1983) contains further discussion of the species and its other varieties. $2n=18$ (Beaudry, 1963).

5. SOLIDAGO CANADENSIS L. Sp. Pl. 2:878. 1753. *Common Goldenrod.* Figs. 1, 4.

TYPE: Habitat in Virginia, Canada (LINN, Microfiche US!).

The branches of the inflorescence are usually secund, with pyramidal inflorescences. Leaves are pubescent on both sides. A weedy species occurring throughout Oklahoma and Texas where it is represented by several varieties. Ranked as the sixth most important forb in lowland prairies based on 135 areas from Kansas to South Dakota (Weaver, 1968). Key adapted from Croat (1972).

KEY TO VARIETIES

1. Inflorescence usually a compact pyramid, branches recurved; flowers secund; east of Trans-Pecos area.
    2. Involucre usually less than 2.8 mm high, disk flowers usually 3 or fewer (rarely 5), corollas less than 3 mm long .... var *hargeri*
    2. Involucre more than 3 mm high; disk flowers more than 3, corolla longer than 3 mm.
        3. Plants usually more than 8 dm tall; leaves usually more than 7 cm long, pubescence on upper surface shorter and less dense than below; open areas in eastern forests .... var. *scabra*
        3. Plants usually less than 7 dm tall; leaves less than 7 cm long, pubescence nearly the same on both sides; prairies and floodplains farther west .... var. *gilvocanescens*
1. Inflorescence typically elongate and scarcely secund and recurved; Trans-Pecos .... var. *salebrosa*

5a. var. GILVOCANESCENS Rydb. Contr. U.S. Natl. Herb. 3:162. 1895.

TYPE: NEBRASKA. Hooker Co.: sandy soil near water, Cody's Lakes, 10 Aug 1893, *Rydberg 1662* (HOLOTYPE: NY, microfiche DUR!; ISOTYPES: GH!, US!).

S. gilvocanescens (Rydb.) Smyth. Trans. Kansas Acad. Sci. 16:61 1899.
S. pruinosa Greene. Pittonia 4:70. 1899. TYPE: CANADA. SASKATCHEWAN, Moose Jaw, Assiniboia, 13 Aug 1895, *Macoun 10893, 10894* (CAN).

The differences between this variety and var. *scabra* are not clear cut, with many intermediates occurring. Generally the combination of shorter plants with smaller thicker leaves that are gray-green with uniform pubescence on both sides and with fewer teeth or even entire margins are the var.

gilvocanescens. This is the common variety of the tall grass prairies of the central portion of both states. It extends eastward along roadsides and other disturbed habitats, and westward up the floodplains of rivers and along wet roadsides, becoming established in irrigation facilities. It is capable of spreading in large clones over several acres. 2n = 18, 36 (Beaudry, 1963).

NOTE: *S. canadensis* var. *canescens* Gray, Proc. Amer. Acad. Arts 17:197. 1882. [*S. altissima* var. *canescens* (Gray) M. C. Johnst., Southw. Naturalist 14:372. 1970] is reported from southwest Texas based on collections by Berlandier, Lindheimer, Bigelow, and from southern New Mexico by Thurber. The description of narrow, entire leaves and its range indicate this plant is most likely not a variety of *S. canadensis* but of *S. velutina.* The type of this taxon has not been located.

5b. var. HARGERI Fern. Rhodora 17:11. 1914.

TYPE: CONNECTICUT. New Haven Co.: roadside near the Housatonic River at Bennett's Bridge, Southbury, 1 Oct 1901, *E. B. Harger s. n.* (HOLOTYPE: GH!).

The smaller heads are distinctive. However, measurements must be made on mature flower heads as young heads of other varieties can be mistaken for this taxon. Vegetative characters are similar to var. *scabra.* Mostly found in the eastern portion of coastal Texas, southeastern Oklahoma, and northern Oklahoma. 2n = 18 (Beaudry, 1959).

5c. var. SCABRA T. & G. Fl. N. Amer. 2:224. 1824.

TYPE: The type specimen may be a Muhlenberg specimen at PH which could be the plant that Muhlenberg described in his manuscript, Flora Lancastriensis, which Torr. & Gray redescribed as a new variety of *S. canadensis.* The Muhlenberg specimen at B, type of *S. scabra* Muhl. ex Willd., is *S. rugosa* and matches the description of Willdenow in Sp. Pl.

S. altissima L. Sp. Pl. 2:878. 1753. Habitat in America Septentrionale (LINN, Microfiche US!).

S. altissima var. *pluricephala* M. C. Johnst. Southw. Naturalist 14:372. 1970. TYPE: TEXAS. Cameron Co.: 15 Sep 1960, *R. J. Fleetwood 3321* (HOLOTYPE: TEX).

This variety is not always readily separated from var. *gilvocanescens.* A combination of larger plants with large thin green leaves having a difference in density on the upper and lower leaf surfaces, with margins well toothed are good representatives of this taxon. This is the more commonly collected variety in eastern parts of Oklahoma and Texas. Despite the morphological gradation between varieties in this wide ranging species, there has been resistance to acceptance of this taxon at the varietal level. 2n = 54 reported as *S. altissima* from Dallas, Texas (Beaudry, 1963) and from elsewhere (Beaudry, 1959).

5d. var. SALEBROSA (Piper) Jones. Bull. Montana State Univ., Biol. Ser. 15:49. 1910.

S. serotina var. *salebrosa* Piper. Fl. Palouse Region 185. 1901. TYPE: WASHINGTON. Pullman, *Piper 1580.*

S. elongata Nutt. Trans. Amer. Philos. Soc. 7:327. 1841. TYPE: Wappatoo Island and plains of the Oregon (label: plains of the Columbia). *Nuttall* (LECTOTYPE: PH!).

S. serra Rydb. Bull. Torrey Bot. Club 31:650. 1905. TYPE: COLORADO. Yampa, *Shear & Bessey 5274* (HOLOTYPE: NY, microfiche DUR!).

S. polyphylla Rydb. Bull. Torrey Bot. Club 31:651. 1905. TYPE: COLORADO. Canyon City, *Clements 295* (HOLOTYPE: NY, microfiche DUR!).

S. lepida DC. var. *elongata* (Nutt.) Fern., Rhodora 17:9. 1915.

S. canadensis L. subsp. *salebrosa* (Piper) Keck, Aliso 4(1):104. 1958.

A western variety extending eastward in the United States to the Guadalupe-Davis Mountains in southwest Texas, it is sparsely pubescence as compared with other varieties, has thinner leaves, and mostly erect or only rarely recurved branches in the inflorescence.

6. SOLIDAGO GIGANTEA Ait.

Solidago gigantea is a mesic plant, most often occurring in wet roadside ditches, along floodplains, and adjacent to lakes and ponds. It begins blooming in midsummer but can continue late into the fall. Therefore, it can often have abnormal inflorescences coming from lateral branches. These are tall plants up to 1.5 m or more and can produce large clones from rhizomes or occur as single plants. The heads are about 6 mm high when mature.

KEY TO VARIETIES

1. Leaves glabrous .... var. *serotina*
1. Leaves sparsely long pubescent on midrib of lower leaf surface .... var. *gigantea*

6a. var. GIGANTEA. Hortus Kew. 3:211. 1789. *Giant Goldenrod.* Figs. 1, 4.

TYPE: Based on a specimen from Kew Gardens originating in North America and cultivated 1758 by Mr. Philip Miller (BM).

S. serotina Ait. var. *gigantea* (Ait.) Gray. Syn. Fl. N. Amer. 2:156. 1884.

A rare plant in eastern Oklahoma and east Texas that is known only from a few collections (Taylor & Taylor, 1978). 2n=18, 36 (Beaudry & Chabot, 1959, Beaudry, 1963).

6b. var. SEROTINA (Ait.) Cronq., Vasc. Plants Pacific Northwest 5:306. 1955.

S. serotina Ait. Hortus Kew. 3:211. 1789. TYPE: native of North America, flowering July, Aug. cultivated 1758 by Mr. Philip Miller (BM).

Aster latissimifolius (Mill.) O. Ktze. var. *serotinus* (Ait.) O. Ktze. Revis. Gen. Pl. 1:314. 1891.

S. pitcheri Nutt. J. Acad. Nat. Sci. Philadelphia 7:101, 102. 1834. TYPE: ARKANSAS TERRITORY [probably Ft. Gibson in present Oklahoma where Dr. Pitcher was stationed]. *Dr. Pitcher s.n.* (LECTOTYPE: PH!).

S. gigantea var. *leiphylla* Fern. Rhodora 41:457. 1939.

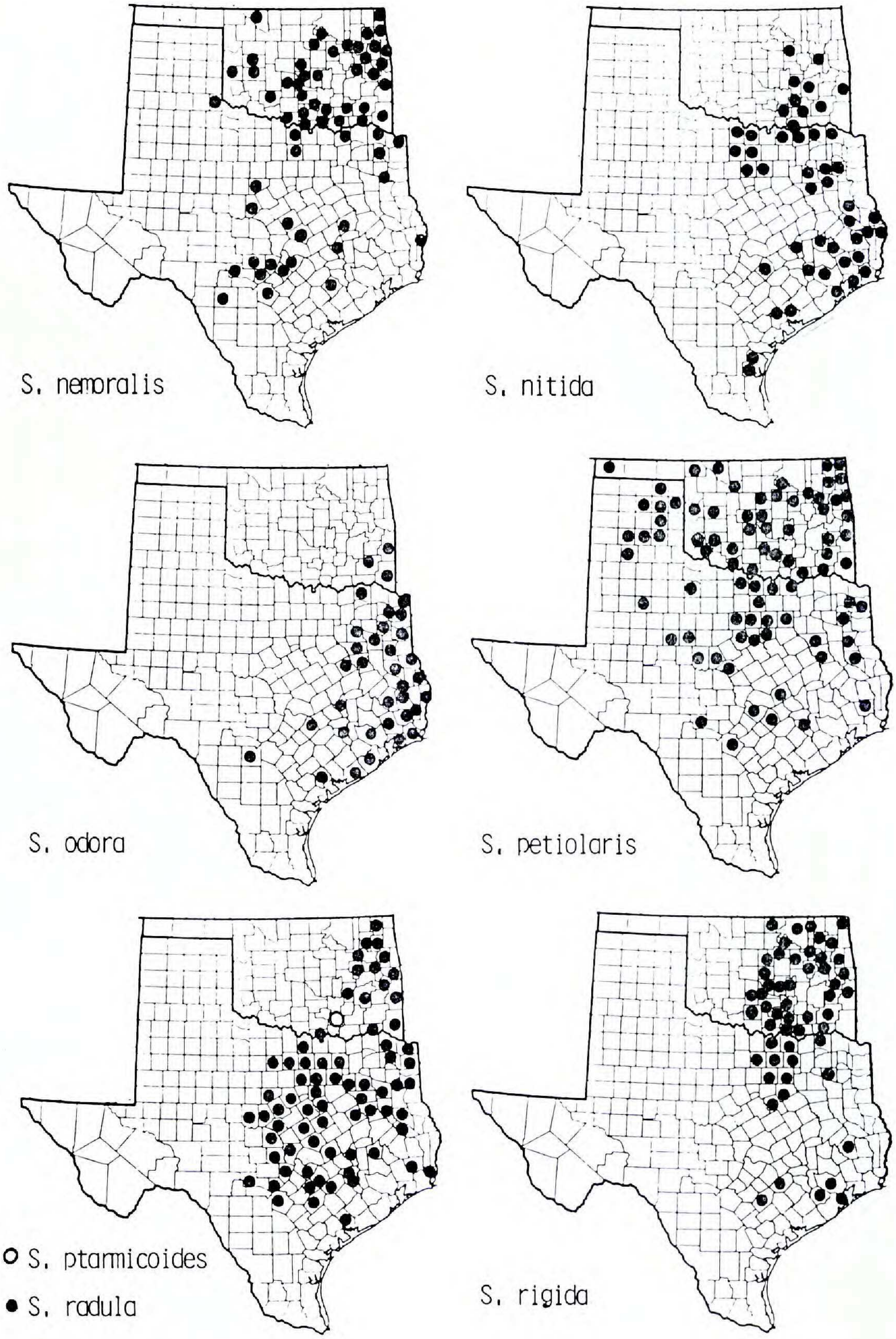
S. nemoralis
S. nitida
S. odora
S. petiolaris
○ S. ptarmicoides
● S. radula
S. rigida

Figure 2.

A common goldenrod, usually with red stems, that blooms over a long season and frequently has atypical or abnormal inflorescences late in the season. This variety is most often confused with *S. missouriensis*, (especially those plants in southwestern Oklahoma and Texas that also have a pubescent inflorescence). *Solidago gigantea* has wider leaves that are uniform in width over a major portion of the leaf and are toothed along most of the leaf edge. *Solidago missouriensis* has smaller leaves, tapered at both ends and the teeth are fewer, smaller, and mostly apical. 2n = 18, 36 (Beaudry, 1963 reported as *S. g.* var. *leiophylla*; Beaudry & Chabot, 1959).

7. SOLIDAGO HISPIDA Muhl. ex Willd. Willdenow Sp. Pl. 3:2063. 1803. *Hispid Goldenrod.* Figs. 1, 7,

TYPE: Habitat in Pennsylvania (Willdenow Collection, B, microfiche US!; ISOTYPE PH!).

S. bicolor L. var. *concolor* T. & G. Fl. N. Amer. 2:197. 1842. TYPE: KENTUCKY. [Lexington] *Dr. Short s.n.* (LECTOTYPE: GH!).

This occasional plant of the drier oak-hickory forests produces one or two stems per plant with a distinctive pilose pubescence. It is very closely related to *S. bicolor* which has white ray flowers. Though the taxa with different ray flower colors are considered as separate species, it is apparently the main character separating them. 2n = 18 (Beaudry & Chabot, 1959).

8. SOLIDAGO MISSOURIENSIS Nutt. var. FASCICULATA Holz. Contr. U.S. Natl. Herb. 1:208. 1892. *Missouri Basin Goldenrod.* Figs. 1, 4.

TYPE: INDIAN TERRITORY, Cherokee Outlet, Aug 1891, *W. A. Carlton 430* (HOLOTYPE: US!).

This area is in northern Oklahoma and it extended from present Osage County west to Ellis and Harper counties. The type specimen at US had apical meristem damage, and the two stems have very narrow leaves which are not typical of undamaged plants.

Most plants growing in Oklahoma have a glabrous inflorescence, the character most often used in keys to separate this species from *S. gigantea.* But *S. missouriensis* plants in southwestern Oklahoma and Texas have a sparse pubescence in the inflorescence. There appears to be no other difference. Such sparse pubescence can also be found in specimens from the southwestern United States. Our variety of *S. missouriensis* differs from var. *missouriensis* in being taller than 20 cm and commonly with fastigiate branching.

Weaver (1968) reported *S. missouriensis* to be a common member of upland prairies (ranking 6th among forbes) from Kansas to South Dakota, to increase under grazing, and to do better in drought years than most other prairie species. 2n = 18 reported for *S. missouriensis* (Beaudry, 1963; Beaudry & Chabot, 1959; Solbrig et al., 1964).

9. SOLIDAGO MOLLIS Bartl.

Rarely collected, this species of the high plains has small basal leaves which are generally absent at anthesis. Stem leaves are sessile, somewhat 3-ribbed, and mostly elliptic or oval to rarely obovate, with entire margins, and stem leaves imbricated. The pyramidal inflorescence and gray leaves often cause it to be mistaken for *S. canadensis* var. *gilvocanescens* which usually has small teeth near the leaf tip and lateral veins which are straight. Actual leaf texture, pubescence, and head size reveal the close relationship of *S. mollis* with *S. radula.*

KEY TO VARIETIES

1. Leaves elliptic to oval; inflorescence pyramidal .... var. *mollis*
1. Leaves narrowly obovate; inflorescence frequently longer than wide ... var. *angustata*

9a. S. MOLLIS Bartl. var. MOLLIS. Ind. Sem. Hort. Gotting. 5. 1836. *Northern Plains Goldenrod.* Figs. 1, 4.

TYPE: Based on a cultivated specimen, from seed collected by Prince Neu-wied, in the Botanic Garden of Halle.

In western Oklahoma, this variety has uniformly elliptic to broadly oval leaves. It has been rarely collected from gypsum outcrops or escarpments in western Oklahoma where it is at the southern end of its range. This plant is much more common in the northern short- and mid-grassland habitats of the High Plains.

9b. var. ANGUSTATA Shinners. Field & Lab. 19:34. 1951.

TYPE: TEXAS. Wilbarger Co.: prairie along railroad track, 6 mi W of Electra on Hwy 287, 27 Oct 1945, *Whitehouse 10912* (SMU!).

Endemic to extreme south central Oklahoma and north central Texas (Hall, Wichita, Wilbarger cos., Texas; Jackson County, Oklahoma), this taxon appears to be intermediate between *S. mollis* and *S. radula.* The ranges of these two species meet in north central Texas. *Solidago radula* specimens often have similar leaves but usually have a much more divergent inflorescence, and leaf variation is from spathulate to broadly ovate to elliptic. The habitat of *S. radula* is dry rocky breaks and xeric roadsides and perhaps has been introduced into the eastern United States by way of the Red River valley. *Solidago mollis* var. *angustata* occurs in escarpment areas, particularly where gypsum is exposed and is confined to xeric habitats.

10. SOLIDAGO NEMORALIS Ait.

Solidago nemoralis grows in clumps of several stems and usually is found in drier upland sites in sunny locations. It is extremely variable in inflorescence and leaf shape, and a population along a roadside will be impressive in the differences of habit among individuals. This wide ranging eastern species usually has a basal rosette and persistent lower leaves which are spathulate and entire to toothed. The lower leaves usually are over 5 times longer than wide and uniformly densely puberulent with short hairs. Only the medvein is apparent on leaves. 2n=18 (Beaudry, 1963).

KEY TO VARIETIES

1. Main stem leaves oblanceolate to obovate, the upper gradually reduced in size, the lower ones of the stem 3–6 times as long as broad; involucres 3–4.5 mm high .... var. *nemoralis*
1. Main stem leaves linear-oblanceolate to linear, the lower ones 7–10 times as long as broad; involucres 4.5–6.5 mm high .... var. *longipetiolata*

10a. S. NEMORALIS Ait. var. NEMORALIS. Hortus Kew. 3:213. 1789. *Old-field Goldenrod.* Figs. 2, 4.

TYPE: Native of North America, introduced by Samuel Martin, M.D., Sept, 1769.

An eastern variety, this taxon extends to the eastern portions of Oklahoma and Texas. The type at GH of var. *haleana* Fern. has broad leaves but the inflorescence represents a very aberrant form not represented by any plants in our area; our branched inflorescence forms do not warrant taxonomic recognition.

10b. var. LONGIPETIOLATA (Mack. & Bush) Palmer & Steyerm. Ann. Missouri Bot. Gard. 22:660. 1935.

S. longipetiolata Mack. & Bush. Trans. Acad. Sci. St. Louis 12:87. 1902. TYPE: MISSOURI. Jackson Co.: Lee's Summit, 9 Sep 1901, *Mackenzie 425* (HOLOTYPE: NY, microfiche DUR!).
S. decemflora DC. Prodr. 5:332. 1836. TYPE: TEXAS in the eastern districts, *Berlandier*, 1824. (HOLOTYPE: G, microfiche US!; ISOTYPE: US!).
S. diffusa A. Nels. Bull. Torrey Bot. Club 25:378. 1898. TYPE: WYOMING. Badger, 27 Aug 1896, *Nelson 2761* (RM).
S. pulcherrima A. Nels. Bull. Torrey Bot. Club 25:549. 1898. Based on *S. diffusa* A. Nels.
S. n. var. decemflora (DC). Fern. Rhodora 38:226. 1936.

In the western regions, this is the more common variety and the only variety in the northwestern United States and it is common in the northern Great Plains. The young flower heads are eaten by wild turkey, and the basal leaves are a source of food during winter for the white-tailed deer.

11. SOLIDAGO NITIDA T. & G. Fl. N. Amer. 2:210. 1842. *Flat-topped Goldenrod.* Figs. 2, 6.

TYPES: "Dry pine woods, western Louisiana, *Dr. Leavenworth! Dr. Hale!* and Texas, *Drummond*! *Dr. Leavenworth*!" Alexandria, Louisiana, *Dr. Hale* (LECTOTYPE NY, microfiche DUR!).

This summer-blooming goldenrod of the southeastern United States is distinctive with its flat-topped inflorescence and multiveined involucral bracts. It has, in the past, been placed in the genus *Oligoneuron* along with

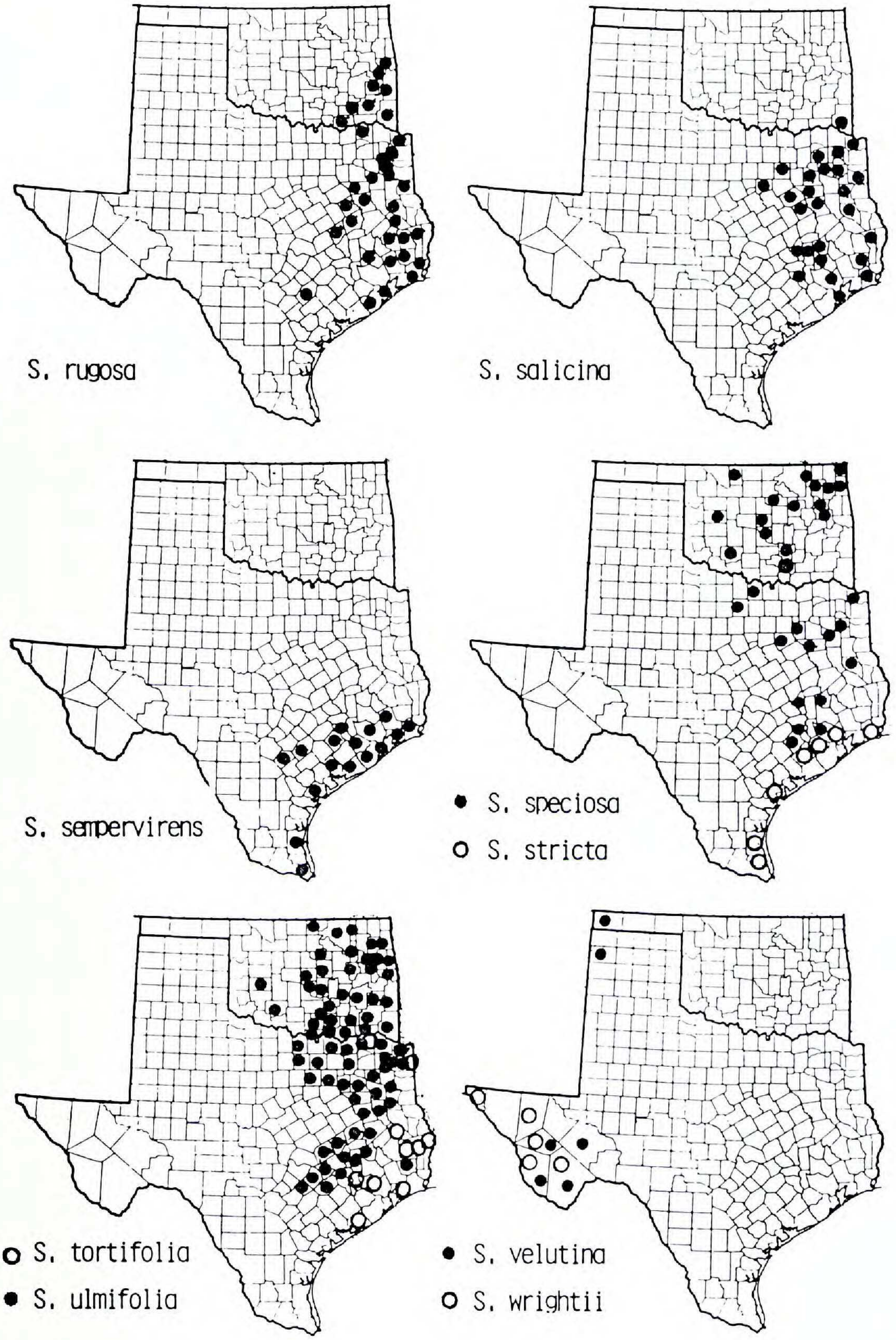
S. rugosa
S. salicina
S. sempervirens
● S. speciosa
○ S. stricta
○ S. tortifolia
● S. ulmifolia
● S. velutina
○ S. wrightii

Figure 3.

related species. Recent work by Anderson & Creech (1975) indicates its closest alliance is with *Solidago*. It is confined to moist prairies and disturbed areas in eastern Oklahoma and eastern Texas. 2n=18 (Cronquist, 1980).

12. SOLIDAGO ODORA Ait. Hortus Kew. 3:214. 1789. *Sweet Goldenrod.* Figs. 2, 4.

TYPE: Native of North America, cultivated by Mr. James Gordon, July, Aug, 1763.

S. puncticulata DC. Prodr. 5:332. 1836. TYPE: MEXICO. Rio de la Guadelupe, *Berlandier* (pl. exs. no. *1900*). 1839 (G, US!).

The very narrow, small heads and glandular-dotted leaves are very distinctive. The leaves are glabrous and the stem has lines of hairs below the edge of the leaf attachment or is more pubescent with a glabrous area below the leaf node. A common plant along roadsides and in pine woods of the eastern portion of Texas, it barely extends into Oklahoma. Most plants have leaves with an anise odor when crushed and can be used for brewing tea.

13. SOLIDAGO PETIOLARIS Ait.

The heads of *S. petiolaris* are the largest of any of our goldenrods. Extremely large specimens have the lower larger leaves serrate. Growing in dense bunches with many stems, it does not spread by underground rhizomes into large clones. It is closely related to *S. wrightii* of southwestern Texas.

KEY TO VARIETIES

1. Leaves scarcely or not at all sticky or resinous, lower surface and main veins more or less hairy with spreading hairs; involucral bracts minutely hairy with hairs often sticky, but sometimes glabrous ....var. *petiolaris*
1. Leaves prominently sticky or resinous, lower surface glabrous; involucre glandular-dotted, essentially glabrous ....var. *angusta*

13a. S. PETIOLARIS Ait. var. PETIOLARIS. Hortus Kew. 3:216. 1789. Figs. 2, 7.

TYPE: Native of North America, cultivated by Mr. Philip Miller, Oct, Dec, 1758.

S. wardii Britt. Man. Fl. N. States. 935. 1901. TYPE: KANSAS. Clark Co.: 8 mi W of Ashland, 2 Oct 1897, *L. F. Ward s.n.* (GH!).
S. petiolaris var. *wardii* (Britt.) Fern. Rhodora 10:87. 1908.

Leaves are lanceolate to occasionally ovate. More common in the prairies and short grasslands of western regions. 2n=18 (Beaudry, 1963).

13b. var. ANGUSTA (T. & G.) Gray. Proc. Amer. Acad. Arts 17:189. 1882.

S. angusta T. & G. Fl. N. Amer. 2:204. 1842. TYPE: Alexandria, western Louisiana, *Dr. Hale* [HOLOTYPE: NY, microfiche DUR!].
S. lindheimeriana Scheele. Linnaea 21:599. 1848. TYPE: Flora Texana exsiccata, Oct 1848, *Lindheimer 417* (GH!, US!).

Generally more common in the eastern portions of Oklahoma and Texas, it is occasionally found in western regions.

14. SOLIDAGO PTARMICOIDES (Nees) Boivin. Phytologia 23:21. 1972. Figs. Figs. 2, 6.

Doellingeria ptarmicoides Nees. Gen. Sp. Aster. 183. 1832. Based on *Chrysopsis alba* Nutt. Gen. N. Amer. Pl. 2:152. 1818; not *S. alba* Miller.
Aster ptarmicoides (Nees) T. & G. Fl. N. Amer. 2: 160 1841.

A white-rayed species with fiat-topped, loose, few-headed inflorescences and linear leaves known only in our region from the Baum Limestone area of southcentral Oklahoma, where it has evidently been introduced (Taylor & Taylor, 1978).

With the white rays and few heads, its overall aspect and habit are similar to *Aster*. Studies in leaf anatomy (Anderson & Creech, 1975) indicate this species is allied to the *Oligoneuron* section of *Solidago* from which it differs in having less prominent bundle sheath extensions.

15. SOLIDAGO RADULA Nutt. J. Acad. Nat. Sci. Philadelphia 7:102. 1834. Figs. 2, 4.

TYPE: ARKANSAS. (At the time of Nuttall's visit in 1819, the western boundary of Arkansas Territory was located 40 mi west of the present Oklahoma-Arkansas state line. He collected extensively in what is now southeastern Oklahoma).

S. rotundifolia DC. Prodr. 5:339. 1836. TYPE: Prov. Texas distr. orientalibus, *Berlandier* (pl. exs. n. 1884; G).
S. scaberrima T. & G. Fl. N. Amer. 2:221. 1842. TYPE: TEXAS. *Drummond*, Coll. III, No 138 (HOLOTYPE: NY, microfiche DUR!).
S. pendula Small. Fl. SE U.S. 1197, 1339. 1903. TYPE: ARKANSAS. Benton Co.: *Plank*, 1899 (HOLOTYPE: NY, microfiche DUR!).

Plants frequent in eastern area on dry bluffs and other xeric sites. Inflorescence is usually several-branched with the upper branches long and floriferous and the lower half with small, elliptic leaves. This is one of the few goldenrods in which the heads are not secund, but appear to equally surround the stem. This character is obvious in the field but may be distorted during pressing. Plants occur in clusters or bunches and are closely related to *S. mollis* with comments concerning relationship between these species under that species. It is not closely related to any of the other species of the eastern United States. 2n=18 (Beaudry, 1963).

16. SOLIDAGO RIGIDA L. Sp. Pl. 2:880. 1753. Figs. 2, 6.

TYPE: "Habitat in Pennsylvania." The specimen in the Linnaean Herbarium consists of the upper part of a plant (LINN, microfiche US!).

S. corymbosa Ell. Sketch Bot. S. Carolina 2:378, 379. 1823. TYPE: GEORGIA. Louisville, Sep, Oct, *Mr. Jackson s.n.* Not Poir. Encyc. Suppl. 5:461. 1817.
S. rigida var. *humilis* Porter. Syn. Fl. Colorado 63. 1874. TYPES: COLORADO. Wet

Mountain Valley *Brandegee*, *Porter*; *Coulter*; near Denver, *Dr. Smith*. Not *S. humilis* of Miller, Pursh, or Desfontaines.

Aster jacksonii O. Ktze. Revis. Gen. Pl. 1:316. 1891.

Oligoneuron rigidum (L.) Small. Fl. SE U.S. 1188. 1903.

O. canescens Rydb. Bull. Torrey Bot. Club 31:652. 1904. Based on *S. rigida* var. *humilis* Porter.

S. jacksonii (O. Ktze.) Fern. Rhodora 38:229. 1936.

S. canescens (Rydb.) Friesner. Butler Univ. Bot. Studies 4:196. 1940.

S. rigida var. *glabrata* Braun. Rhodora 44:3. 1943. TYPE: KENTUCKY. Barren Co.: dry soil near Cave City, 11 Sep 1940, *Braun 3629* (GH!).

S. rigida var. *laevicaulis* Shinners. Field & Lab. 19:35. 1951. TYPE: TEXAS. Dallas Co.: limestone soil, 2 mi N of Cedar Hill, 11 Nov 1947, *Whitehouse 19269* (SMU!).

S. jacksonii var. *humilis* (Porter) Beaudry. Canad. J. Genet. & Cytol. 5:170. 1963.

The large heads, flat-topped inflorescence, and ovate leaves make this taxon distinctive. This is a wide ranging prairie and short grassland species occurring in the United States and Canada east of the Rocky Mountains.

As with most *Solidago* species, it varies from small to robust and from densely canescent to glabrate or more rarely glabrous. Beaudry (1963) divides this species into three entities. One species is the eastern pubescent robust tetraploid based on his counts from Almont, Penn., near the type location. The other smaller diploid plants, pubescent, glabrate, or glabrous represent a separate species with two varieties. The smaller glabrous taxon is regarded as *S. jacksonii* var. *jacksonii* (synonyms: *S. rigida* var. *glabrata* and *S. r.* var. *laevicaulis*). The pubescent plants which are the most common in the southern grasslands are referred to *S. jacksonii* var. *humilis*. Specimens of *S. rigida* in our area are just as robust as any from the eastern United States. Height and flower production varies considerably depending on availability of moisture, such as growing in a roadside ditch as opposed to growing on sloping ground above the ditch. Robustness, an environmental expression, is not a valid taxonomic character and this taxon should not be recognized as two separate species despite the tetraploidy of a few plants. $2n=18$ reported as *S. jacksonii* var. *jacksonii*, N Dallas, Texas (Beaudry, 1963).

17. SOLIDAGO RUGOSA Mill.

KEY TO VARIETIES

1. Leaves lanceolate, reticulation not pronounced beneath .... var. *rugosa*
1. Leaves broadly lanceolate to ovate, reticulation pronounced beneath ..... var. *aspera*

17a. S. RUGOSA Mill. var. RUGOSA. Gard. Dict. Ed. 8. species no. 25. 1768. *Rough-leaf Goldenrod.* Figs. 3, 5.

TYPE: "Probably there is no type extant for *Solidago rugosa*." (Fernald, 1936).

S. scabra Muhl. ex Willd. Sp. Pl. 3(3): 2059. 1803. TYPE: *Muhlenberg* (B, microfiche 4201, US!).

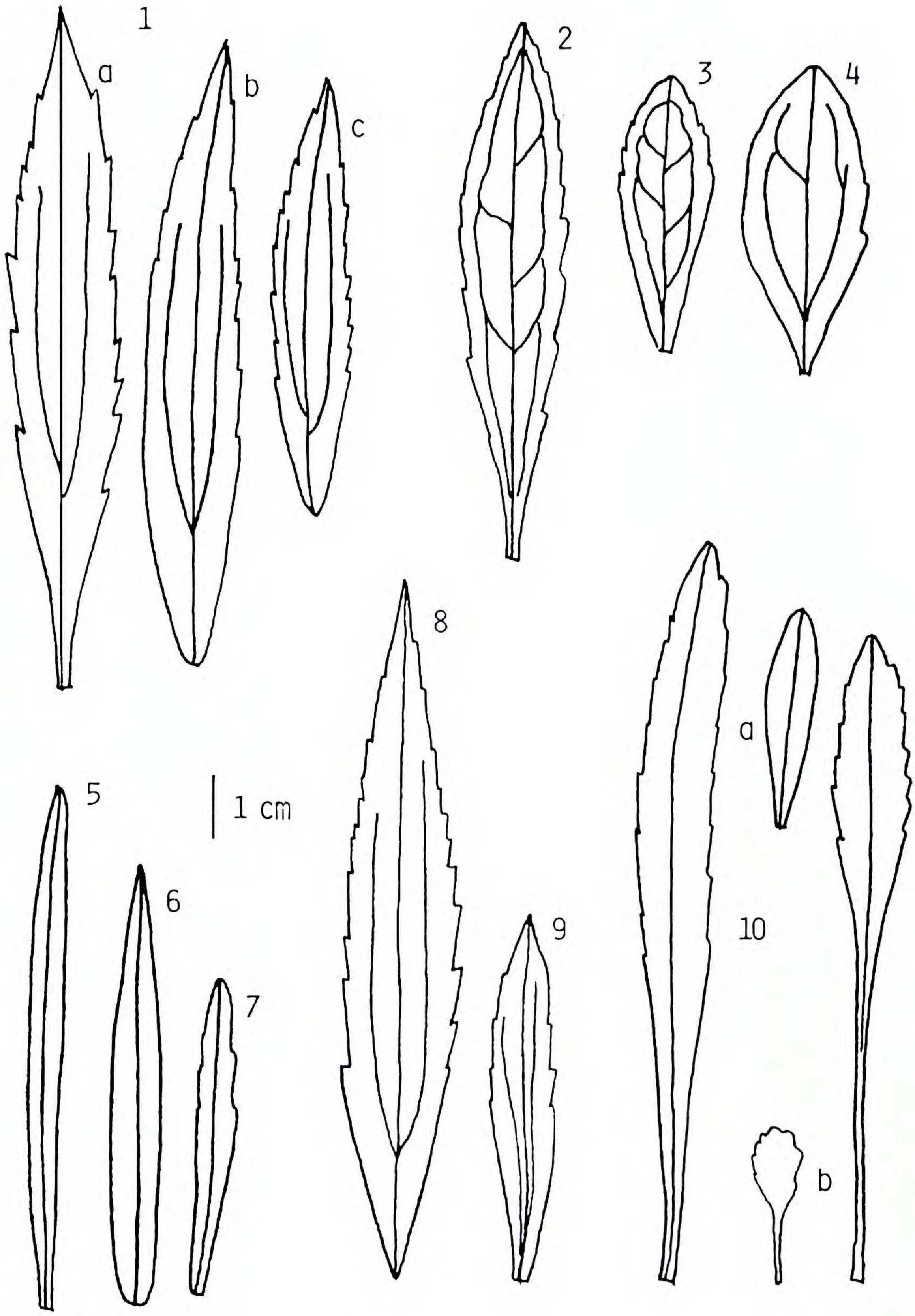

Figure 4. 1. *Solidago canadensis*, a. var. *scabra*, b. var. *gilvocanescens*, c. var. *salebrosa*; 2. *S. velutina*; 3. *S. radula*; 4. *S. mollis*; 5. *S. altiplanities*; 6. *S. odora*; 7. *S. tortifolia*; 8. *S. gigantea*, 9. *S. missouriensis*, 10. *S. nemoralis*, a. stem leaves, b. basal leaves.

Variety *rugosa* is a less frequently collected taxon which might be confused with *S. ulmifolia.* Generally, *S. rugosa* has a pubescent stem while *S. ulmifolia* has a glabrous stem. Occasionally plants have been seen that appear to be hybrids between the two species. In our area the species are sometimes sympatric, but they occur in different habitats. *Solidago rugosa* usually is found in roadside ditches and along streams and moist sites in oak-hickory forest while *S. ulmifolia* is confined to sunny openings in blackjack-post oak woods or dryer upland sites. *Solidago ulmifolia* blooms in the summer and has generally completed flowering when *S. rugosa* begins to flower.

17a. var. ASPERA (Ait.) Fern. Rhodora 17:7. 1915.

> *S. aspera* Ait. Hortus Kew. 3:212. 1789. TYPE: Native of North America, cultivated, Sept, 1732 by James Sherard, M.D. (BM).
> *S. celtidifolia* Small. Fl. SE U.S. 1198, 1339. 1903. TYPE: MISSISSIPPI. Biloxi, *Tracy 5058* (HOLOTYPE: NY; photograph: Rhodora 38:227. 1936).
> *S. rugosa* var. *celtidifolia* (Small) Fern. Rhodora 38:223. 1936.

A common variety in our area. Fernald (1936) has a rather complete discussion of the species, including pictures of type specimens. Plants with more lax inflorescences with a few prolonged divergent branches, floriferous past the middle, have been named var. *celtidifolia,* in contrast to compact inflorescences of var. *aspera.* Field studies in Oklahoma and Texas show that the inflorescences in a single, large and spreading clone of plants can vary from compact to widely branching. There is some difference in intensity of vein reticulation, and some leaves are obtuse apically instead of acute, but there is no correlation of characters. The recognition of var. *celtidifolia* is not warranted. 2n=18 (Beaudry, 1953, Goodwin, 1937).

18. SOLIDAGO SALICINA Ell. Sketch Bot. S. Carolina 2:389. 1823. Figs. 3, 5.

> TYPE: GEORGIA. Common in the oak land in the western districts, Sep-Oct.

> *S. patula* Muhl. var. *strictula* T. & G. Fl. N. Amer. 2:213. 1842. TYPE: "North Carolina! to Florida! and Louisiana! Aug.-Sept."
> *S. boottii* Hook. var. *ludoviciana* Gray. Syn. Fl. N. Amer. 2:154. 1884. TYPE: W. Louisiana, *Hale s.n.* (HOLOTYPES GH!).
> *S. ludoviciana* (Gray) Small. Fl. SE U.S. 1199, 1339. 1903.

This plant is very distinctive with its large size, long branches with very small leaves, and upper stem leaves appressed. Flowering stems are joined by underground rhizomes to basal rosettes of large and long petiolate leaves. Our plants are mostly glabrous on stems and leaves, but as is common in other goldenrods, many specimens occur with the upper surface of leaves scabrous. The glabrous forms have been referred to *S. ludoviciana.* Gary Morton (pers. comm.) has studied this taxon throughout its range in the eastern United States and has established its separate identity from *S. arguta* and *S. boottii.* Most of the Texas and Oklahoma plants are glabrous. Those plants with upper leaf surfaces scabrous have been referred to *S. patula* var. *strictula*. Our own field and herbarium studies indicate they are the same entity, and the oldest name appears to be *S. salicina*. It has been found only twice in Oklahoma (Taylor & Taylor, 1978) but is weedy in east Texas.

19. SOLIDAGO SEMPERVIRENS L.

KEY TO VARIETIES

1. Lower inflorescence branches long, recurved, secund; leaves usually succulent, lanceolate, occurring in the inflorescence; width of leaf just below inflorescence (0.5) 1.1 (1.8) cm .... var. *mexicana*
1. Lower inflorescence branches erect; leaves less succulent, narrowly lanceolate, not occurring in inflorescence; width of leaf just below inflorescence (0.3) 0.5 (0.8) cm .... var. *sempervirens*

19a. S. SEMPERVIRENS L. var. SEMPERVIRENS. Sp. Pl. 2:878. 1753. *Seaside Goldenrod*. Figs. 3, 6.

TYPE: "Solidago maritima, habitat in Noveboraceo, Canada." Specimen in LINN consists of two stems in early bud and with lower stem leaves (Microfiche US!).

Our plants simply reflect a southern growth pattern of the northern plants, ours being taller and blooming later. Plants are somewhat pubescent in the inflorescence. It is fairly common inland from the coast. Most plants of this variety have been placed into the var. *mexicana* or have passed under the name *S. stricta*, a closely related taxon. The var. *sempervirens* is much more readily separated from var. *mexicana* than it is from *S. stricta* with which it is reported to hybridize (Cronquist, 1980). The latter has appressed, smaller, upper stem leaves and glabrous inflorescences.

19b. var. MEXICANA (L.) Fern. Rhodora 37:447. 1935.

S. mexicana L. Sp. Pl. 2: 879. 1753. TYPE: Mexico. (LINN, microfiche US!).

This is the more common variety in dune habitats. Studies (Cartica and Quinn, 1980) show succulence of leaves varies in relation to intensity of salt application. The considerable variation expressed by this species thus reflects whether it is a primary dune plant exposed to high amounts of salt spray, or exposed to decreasing amounts in marshes farther inland. This species is confined to the coastal area of Texas.

20. SOLIDAGO SPECIOSA Nutt.

KEY TO VARIETIES

1. Midstem leaves over 2 cm wide; lower leaves usually persistent .... var. *speciosa*
1. Midstem leaves less than 2 cm wide; lower leaves usually deciduous .... var. *rigidiuscula*

20a. S. SPECIOSA Nutt. var. SPECIOSA. Gen. N. Amer. Pl. 2:160. 1818. *Prairie Goldenrod*. Figs. 3, 7.

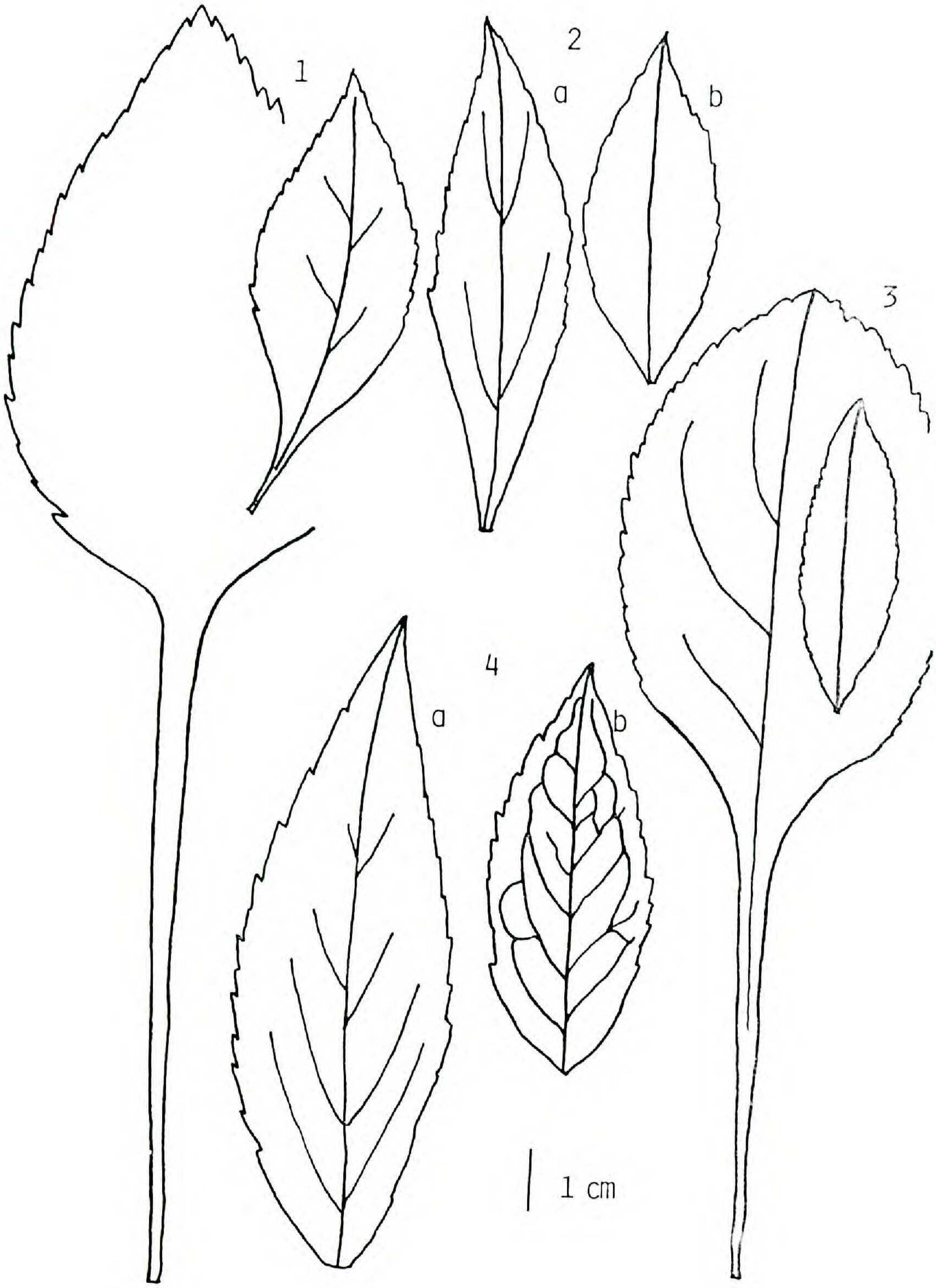

Figure 5. 1. *Solidago arguta*, basal and stem leaves; 2. *S. ulmifolia* a. var. *ulmifolia*, b. var. *microphylla*; 3. *S. salicina*, basal and stem leaves; 4. *S. rugosa*, a. var. *rugosa*, b. var. *aspera*.

TYPE: Habitat in shady woods on banks of the Schuylkill, also in New Jersey; near Philadelphia. (HOLOTYPE: PH!).

Specimens of this variety have been collected in northeastern Oklahoma (Adair County).

20b. var. RIGIDIUSCULA T. & G. Fl. N. Amer. 2:205. 1842.

TYPE: "St. Louis, Missouri and Texas, *Drummond*! *Dr. Engelmann*!; Louisiana, *Dr. Leavenworth*!; Prairies between the Mississippi and Missouri rivers, *Mr. Nicollet*!"

S. rigidiuscula (T. & G.) Porter. Mem. Torrey Bot. Club 5:319. 1894.
S. venulosa Greene. Pittonia 5:138. 1903. TYPE: TEXAS. Palo Pinto Co.: dry hills near Weatherford, 18 Oct 1902, *Tracy 3803* (US!).
S. chandonnettii Steele. Contr. U.S. Natl. Herb. 16:222. 1913. TYPE: MINNESOTA. Ottertail Co.: dry sandy soils, prairie, Perham, 6 Aug 1912, *Chandonnet s.n.* (US!).

A bunched plant of few to several stems that can become a dominant member of prairies. Its present infrequency seems to be due to a decline in native prairies in the midwest.

21. SOLIDAGO STRICTA Ait. Hortus Kew. 3:216 1789 *Seaside Goldenrod.* Figs. 3, 6.

TYPE: Native of North America, cultivated, Sept, 1758 by Mr. Philip Miller (BM).

These wetland to marsh plants are restricted to the coastal zone. A slender plant, with erect narrow inflorescence and small, erect, upper stem leaves that are appressed, is very closely related to *S. sempervirens* and is reported to hybridize with it (Cronquist, 1980). Measurements by Boettcher (1980) clearly show the morphological overlap with *S. stricta* measurements clustering around the smaller sizes. Even more interesting is his composite flavonoid profiles showing close correlation between *S. stricta* and *S. confinis* of the west coast and its submersion in the more diverse profile exhibited by *S. sempervirens*. While its morphological variation indicates submersion in *S. sempervirens*, Boettcher and Cronquist both maintain *S. stricta* as a separate hexaploid species with 2n=54.

22. SOLIDAGO TORTIFOLIA Ell. Sketch Bot. S. Carolina 2:377. 1823. *Twisted Leaf Goldenrod.* Figs. 3, 4.

TYPE: Based on *S. odora* of Michx. Fl. Bor. Amer. 2:118. 1803, not Ait., Hortus Kew. 3:214. 1789. "Hab. in Carolina inferiorae," (Willdenow collection, at B, microfiche US!).

Closely allied to *S. odora*, this few-flowered, small-headed goldenrod has pubescent stems and is moderate to densely scabrous on midrib and upper leaf surfaces. Leaves are often twisted. Overall, its characters cluster toward the smaller measurements in leaf size and inflorescence (leaf width about 4 mm, leaf length 3.5–4 cm). Internodes are 5 mm long while those of *S. odora* are about 11 mm long. Many specimens appear to be morphologically intermediate in size and pubescence, at least in our area where the plants are much larger than those from Florida. n=9 (Cronquist, 1980).

23. SOLIDAGO ULMIFOLIA Muhl. ex Willd.

KEY TO VARIETIES

1. Leaves ovate; lower inflorescence branches long, floriferous apically .... var. *microphylla*
1. Leaves ovate to lanceolate; inflorescence pyramidal, branches not long and leafy .... var. *ulmifolia*

23a. S. ULMIFOLIA var. ULMIFOLIA. Muhl. ex Willd. Sp. Pl. Ed. 4. 2060. 1803. *Elm-leaf Goldenrod.*

TYPE: Habitat eastern United States, Muhlenberg specimen (B, microfiche US!; ISOTYPE: PH!).

Variety *ulmifolia* is the common variety of the northeastern United States and is occasionally found in northeastern Oklahoma in oak-hickory forests. Plants are usually glabrous, but some can be found with pubescence on the leaves. The primary stem is glabrous, while that of the closely related *S. rugosa* is pubescent. However, the extremely pubescent *S. ulmifolia* var. *palmeri* Cronq. with pilose stems has been collected in the Ouachita Mountains just east of the Oklahoma state line. 2n=18 (Beaudry, 1969).

23b. var. MICROPHYLLA Gray. Proc. Amer. Acad. Arts 17:194. 1882.

S. microphylla (Gray) Engelm. ex Small. Fl. SE U.S. 1198. 1903. TYPE: No specimen citations.

S. delicatula Small. Bull. Torrey Bot. Club 25:474. 1898. TYPE: TEXAS. [Lamar County], prairies near Paris, *J. S. Merriam s.n.* 1872 (LECTOTYPE & ISOTYPE: NY, microfiche DUR!).

S. helleri Small. Bull. Torrey Bot. Club 25:619, 620. 1898. TYPE: TEXAS. Bowie Co.: near Texarkana, 2 Sept 1898. *A. A. & E. G. Heller 4188* (HOLOTYPE: NY, *microfiche* DUR!; ISOTYPES: PH!, US!).

This is the most common variety. The shape of the leaves has caused this plant to be confused with *S. arguta* var. *boottii* which also has elm-shaped leaves and long lower inflorescence branches. See further comments under *S. arguta.* Our plants never have a basal rosette and lower leaves are deciduous at flowering. In our area it is mostly found growing in openings and along roadsides in the blackjack-post oak forest on drier sites. Usually it is found only where both sun and shade occur during the day. 2n=18 from Dallas, Texas (Beaudry, 1963).

24. SOLIDAGO VELUTINA DC. var. NEVADENSIS (Gray) C. & J. Taylor, comb. nov. *Velvety Foothills Goldenrod.* Figs. 3, 4.

S. californica Nutt. var. *nevadensis* Gray. Botany Calif. 1:319. 1876. TYPE: NEVADA. Carson City, 1865, *Anderson s.n.* (HOLOTYPE: GH!).

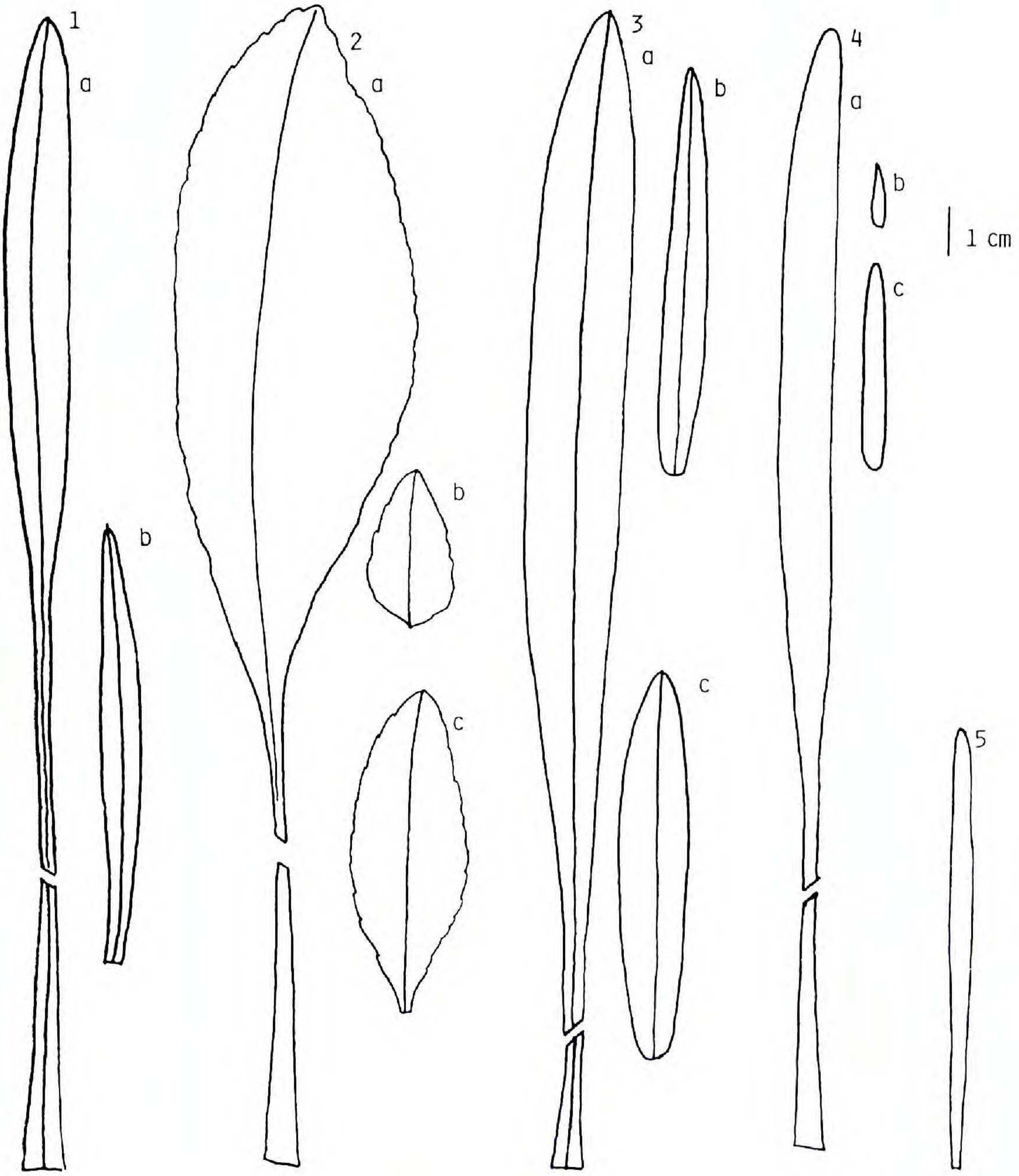

Figure 6. 1. *Solidgo nitida*, a basal leaf, b. stem leaf; 2. *S. rigida*, a. basal leaf, b. & c. stem leaves; 3. *S. sempervirens*, a. basal leaf, b. var. *sempervirens*, stem leaf; c. var. *mexicana*, stem leaf; 4. *S. stricta*, a. basal leaf, b. & c. stem leaves; 5. *S. ptarmicoides*, stem leaf.

S. sparsiflora Gray. Proc. Amer. Acad. Arts. 12:58. 1874. TYPE: ARIZONA. Camp. Lowell, 1874, *Dr. Rothrock 706* (HOLOTYPE: GH!, ISOTYPE: US!).

S. canadensis L. var. *arizonica* Gray. Proc. Amer. Acad. Arts. 17:197. 1882. TYPE: ARIZONA. Boulder Creek, elev 4500 ft, 1874, *Rothrock 782* (HOLOTYPE: GH!; ISOTYPE: US!).

S. trinervata Greene. Pittonia 3:100. 1896. TYPE: COLORADO. Gunnison Canyon, 18 Aug 1896, *E. L. Greene s.n.* (LECTOTYPE: ND!).

S. arizonica (Gray) Woot. & Standl. Contr. U.S. Natl. Herb. 16:181. 1913.

S. howellii Woot. & Standl. Contr. U.S. Natl. Herb. 16:181, 182. 1913. TYPE: NEW MEXICO. Sierra Grande, 15 Aug 1903, *Howell 219* (HOLOTYPE: US!).

This taxon varies considerably in morphology. Leaves vary from widely lanceloate to nearly spathulate with margins sparsely toothed to entire while leaf pubescence is very dense to sparse. The inflorescence can be a compact pyramid to a more open pyramid with the lower branches floriferous only toward the tips. Grazing and drought can cause apical meristem damage giving rise to atypical inflorescences. Our plants represent the eastern edge of the range of *S. velutina*, which was originally collected from the Pacific Coast of Mexico. This species is closely allied with *S. mollis* and *S. radula* of the eastern United States and with *S. californica*, and is one of the more common goldenrods of Mexico. In our area it is found only in extreme southwestern Texas with a single known population in northwest Texas and from the Black Mesa region of Oklahoma. Its habitat is the semi-arid foothills of the Rocky Mountains.

25. SOLIDAGO WRIGHTII Gray.

The extensive variation in this taxon has been discussed by Taylor & Taylor (1983). It was originally separated into varieties based on glandular or eglandular pubescence, but the inflorescence shape and number of heads appear to be more important. This species, which is closely allied to *S. petiolaris* of the eastern United States, needs more study.

KEY TO VARIETIES

1. Heads cymose, singular or few on long pedicels forming a flat-topped inflorescence .... var. *wrightii*
1. Heads paniculate, lower branches of inflorescence leafy, flowers clustered apically .... var. *adenophora*

25a. S. WRIGHTII Gray var. WRIGHTII. Proc. Amer. Acad. Arts. 16:80. 1880. *Wright's Goldenrod.* Figs. 3, 7.

TYPE: TEXAS. Mountains between the Limpia and Rio Grande, Aug, 1849, *Wright 281* (Gray's assigned no.); Arizona. Mt. Graham, alt 9000 ft, *Rothrock 730* (GH!, US!).

S. bigelovii var. *wrightii* Gray. Proc. Amer. Acad. Arts. 17:190. 1882.

Both *S. bigelovii* and *S. wrightii* specimens available to Gray had moderately dense nonglandular pubescence. The few heads and flat-topped appearance make this an unusual goldenrod.

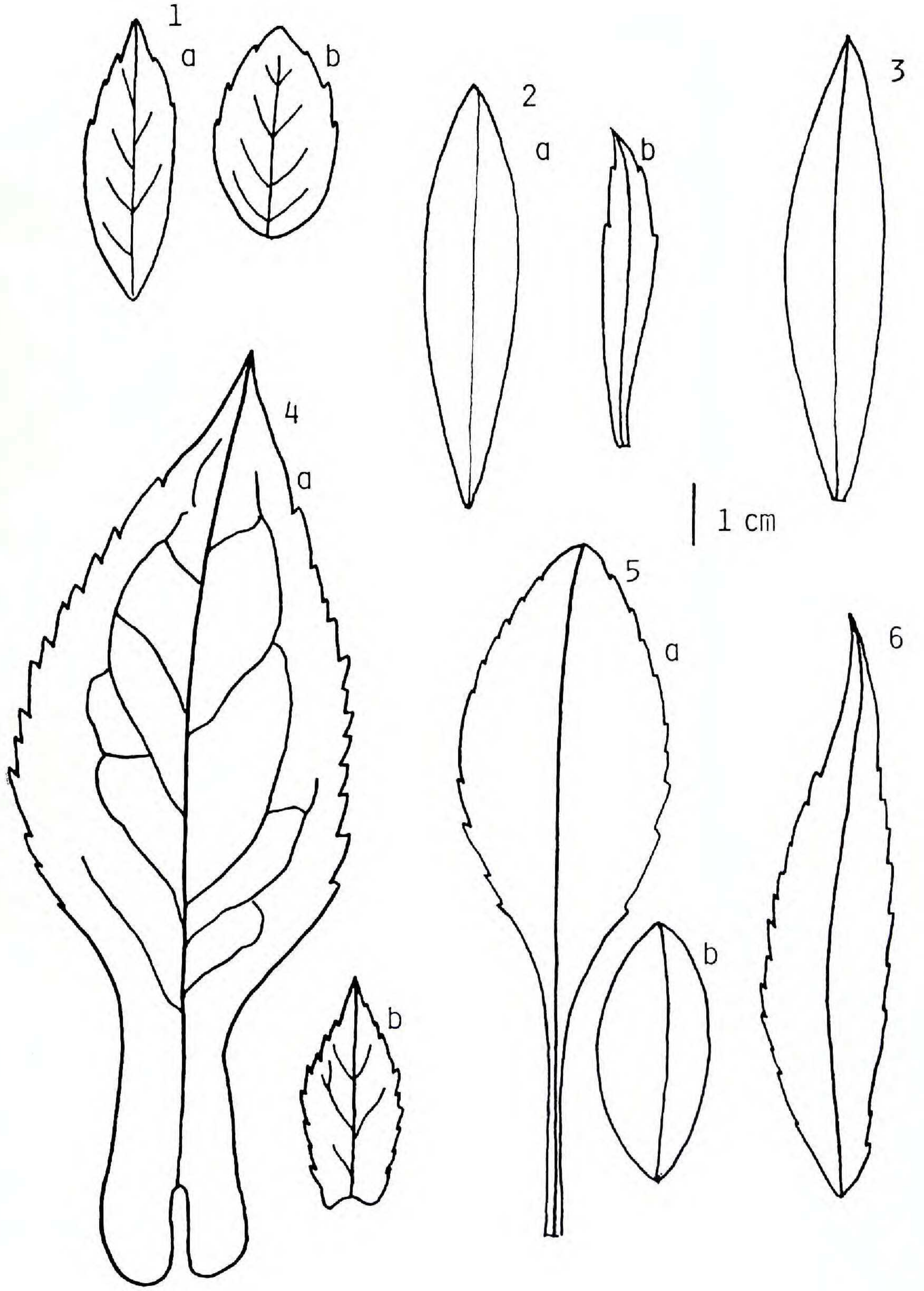

Figure 7. 1. *Solidago petiolaris*, a. var. *angustata*, b. var. *petiolaris*; 2. *S. wrightii*, a. & b. show leaf variation; 3. *S. speciosa*; 4. *S. auriculata*, a. lower stem leaf, b. upper stem leaf; 5. *S. hispida*, a. basal leaf, b. stem leaf; 6. *S. caesia*, stem leaf.

25b. var. ADENOPHORA Blake. J. Wash. Acad. Sci. 19:269. 1929.

TYPE: ARIZONA. Mt. Lemmon, 7500 ft, 4 Aug 1926 *Harrison 3016* (US!).

S. bigelovii Gray. Proc. Amer. Acad. Arts. 17:190. 1882. TYPE: NEW MEXICO. Coppermines, 1851, *Wright 1182* (PH!, US!).

This variety was described by Blake with its emphasis on the abundance of glandular pubescence. However, both glandular and eglandular morphological forms may be found. Leaf variations does not correlate with inflorescence type or pubescence type.

ERRATA AND EXCLUDED SPECIES

In a previous article, Taylor & Taylor (1983), there are two typographical errors concerning dates of publication: *S. caesia* var. *hispida* published in 1845, and *S. flaccidifolia* published in 1898. L. J. Uttal was kind enough to point out that *S. caesia* L. var. *curtisii* had already been made by Wood in his Class-book of Botany.

Excluded species: *Solidago flexicaulis* L. was reported as occurring in McCurtain County, Oklahoma (Taylor & Taylor, 1978).

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